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Field Chlorophyll Measurements May Predict N Needs of Crops

BEING ABLE to predict nitrogen (N) requirements for crops would allow precise applications for efficient N use and protection against surface water contamination with nitrate. Unfortunately, such prediction is difficult. Soil tests have been used successfully in the West, but climatic conditions disallow their use in the humid Southeast. Tissue N tests have shown promise during early crop growth stages, but time for sampling and analyses prevents their timely use.

Measurement of leaf tissue chlorophyll, which is directly related to leaf tissue N, has been proposed as a useful tool for predicting N needs. If successfully correlated with crop yields, field chlorophyll tests have the potential to replace leaf N tissue tests to provide a simple and quick method of predicting N needs.

Hand-held meters are currently available for making chlorophyll measurements, and one of these showed promise for predicting corn N needs in 1990 Alabama Agricultural Experiment Station tests. The meter used weighs less than 1/2 lb., is powered by two AA alkaline batteries, has a 2-second interval between measurements, and can store and average up to 30 measurements. The meters read out in SPAD units, which are directly proportional to tissue chlorophyll content.

The meter was tested on corn at the E.V. Smith Research Center, Shorter. Field chlorophyll measurements and leaf tissue N concentration at the 10-leaf stage of growth (V10) were compared as to their ability to predict corn grain yield and the need for supplemental N fertilization. The relationship between yield and N concentration or chlorophyll level at that growth stage was chosen because the V10 stage of growth is late enough to predict the need for supplemental N but early enough for corn to fully utilize applied N.

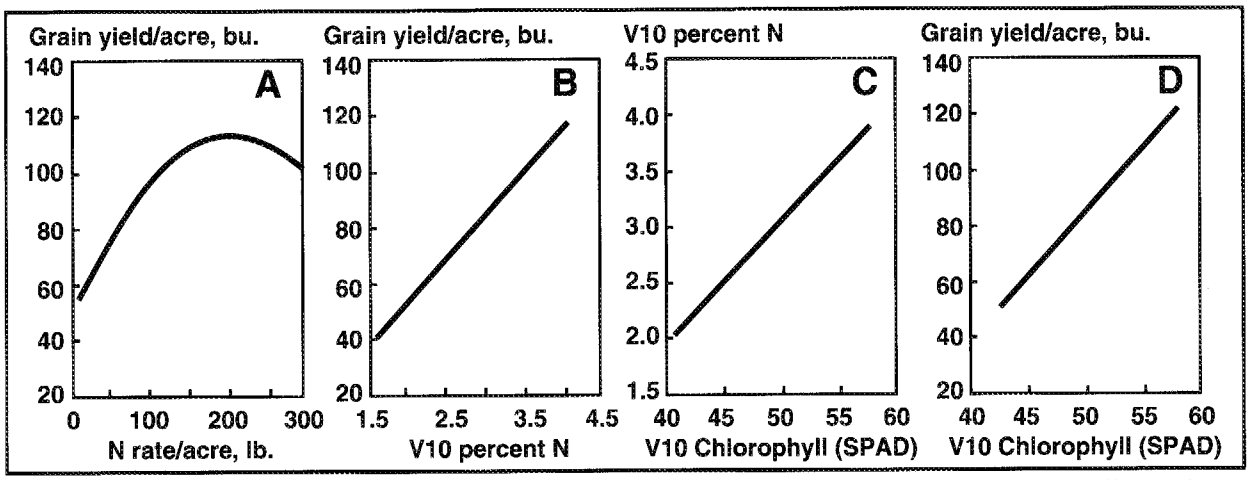
Corn (Dekalb 689) was planted April 18 and nitrogen was broadcast on the soil surface at rates of 0, 50, 100, 150, 200, 250, and 300 lb. per acre 12 days after planting to establish a range of chlorophyll levels, tissue N concentrations, and grain yields. All plots were fertilized with phosphorus, potassium, sulfur, and micronutrients to ensure that elements other than N were not limiting. Irrigation water was applied as needed.

Corn plants were sampled at the V10 stage June 1 for N analysis. Chlorophyll was measured the same day with the hand-held chlorophyll meter. Grain was harvested August 28 and is reported at 15.5% moisture.

A typical response to N fertilization was observed, with peak grain yields of about 115 bu. per acre for 150 to 200 lb., graph A. Higher N rates caused yields to decline.

Tissue N concentration at the V10 stage of growth was a good predictor of grain yield. Grain yields increased linearly with increasing N concentrations at the V10 stage of growth, graph B. In the N rate range that produced peak grain yields (150 to 200 lb.), V10 tissue N concentrations were between 3.7 and 4.0%.

Field chlorophyll measurements were highly correlated with tissue N concentrations at the V10 stage of growth, graph C. The relationship was linear and suggested that field chlorophyll measurements could equal the grain yield and N requirement predictive capabilities of tissue N concentrations. In fact, grain yields were more closely related to V10 chlorophyll, graph D, than to V10 N percent, graph B. The 150- to 200-lb. N rate corresponded to chlorophyll SPAD readings of 55.5 to 56.7, the range equivalent to V10 tissue N concentrations between 3.7 and 3.8%. This agrees closely with the relationship between grain yield and N concentration at the 10-leaf stage. These results suggest that a SPAD reading of 55.5 at the V10 stage of growth might be the threshold level when N should be applied.



Relationship among (A) N rate and grain yield, (B) V10 tissue N concentration and grain yield, (C) V10 tissue chlorophyll level and V10 tissue N concentration, and (D) V10 tissue chlorophyll level and grain yield.

In summary, it appears that field chlorophyll measurements may serve as a good predictor of need for supplemental N fertilization for corn. Field chlorophyll measurements may be superior to chemical tests because of reduced time and increased convenience when compared to tissue chemical analysis.

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